PCT/AU2004/000398

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WITNESS my hand this
Ninth day of April 2004

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AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

HEAD ELECTRICAL INTERNATIONAL PTY LTD

A.C.N. 093 143 027

Invention Title:

AN ELECTRICAL CONNECTION DEVICE

The invention is described in the following statement:

AN ELECTRICAL CONNECTION DEVICE

Field of the Invention

The present invention broadly relates to an electrical connection device for a machine cable. Throughout this specification the term "machine cable" is used for any machine, reeling or trailing cable.

Background of the Invention

Machine cables are typically used to provide an electrical connection for mobile electrical machines. For example, in the mining or petroleum industry often large electrical machinery is used and each machine cable may have to provide power in the order of a few hundred kilowatts. Typically such power is delivered with a voltage of one or more kilovolts. The cables usually comprise a plurality of cores and are connected using electrical connection devices including sockets and pins.

The cores typically are insulated from each other and surrounded by a conductive layer that is on earth potential. Therefore, if the cores break, individual broken cores are less likely to be in electrical contact with each other, but instead are likely to be in electrical contact with respective layers that are on earth potential. Often automatic electrical protection devices are used and in case of electrical contact between one of the cores and one or more layers that are on earth potential, an automatic electrical protection device will detect a leakage current and subsequently interrupt the supply of electricity. Therefore, melt-down of the cable, electrical arcing and the like can largely be avoided. However, within a plug/coupling connection individual cores typically are not surrounded by individual layers on

earth potential but are stripped off the layer and are surrounded by a common electrical casing that is on earth potential. Therefore, if individual cores are disrupted within the plug, it is more likely that the disrupted are in direct electrical contact with each other which will have dangerous consequences especially in an environment that may contain explosive gases such as a mine.

Summary of the Invention

The present invention provides an electrical connection device for connecting a multi-core machine cable to a another electrical device, the multi-core machine cable being of the type having insulated cores individually surrounded by earth-potential layers, the device comprising:

- a body having an end-face, the end-face having apertures,
- insulating sleeves associated with the apertures and extending from the end-face into the body,
- coupling means, each coupling means being connectable to an individual core of the machine cable and being positioned at least in part within a respective one of the insulating sleeves and
- conductive layers surrounding respective insulating sleeves

wherein, in use, each coupling means is connected to a core at a connection area, each conductive layer is connected to a respective earth potential layer, each conductive layer and each insulating sleeve is arranged such that each connection area is surrounded by the insulating sleeve and by the conductive layer.

Each connection means preferably is, in use, surrounded by a respective insulating sleeve and by a respective conductive layer. The electrical connection device most preferably is arranged such that, within the body, each core and the respective coupling means are, in use, surrounded by a respective conductive layer or by the earth potential layer of the respective core. Each insulating sleeve most preferably is surrounded along its length by a respective conductive layer. In this case, within the body of the electrical connection device, each core and the respective connection device is surrounded by an individual conductive layer, that has, in use, earth potential. If cores break within the body, dangerous shorts are less likely to occur as the cores of the broken braches are likely to contact the conductive layers that have earth potential rather than each other. An automatic electrical protection device can then be utilised to interrupt the supply of electricity and the danger of melting of cable insulation, electrical arcing which in an environment that may contain explosive gases such as a mine may result in an explosion, therefore is reduced.

The coupling means may comprise, or may be connected to, a socket. Alternatively, the coupling means may comprise, or may be connected to, a pin.

The individual conductive layers preferably are contactable with ring-like contacts at or within the apertures. The insulating sleeves preferably are provided in form of tubes that may have threads at one end. The ring-like contacts preferably are provided in form of nut that are receivable by the threads of the insulating tubes. In use, each conductive layer preferably is in electrical contact with a respective nut. The end-face preferably is electrically insulating. In this case a

continuation of individual earth-connections to another device is possible by connecting each nut to a respective earth potential layer of the other electrical device. For example, the electrical connection device may comprise pins and the other electrical device may comprise sockets and nuts that are electrically connected to respective earth potential layers of the other device. In this case continuos earth connections can be established by face-to-face connection of respective nuts. This arrangement has the particular advantage that technical testing procedures of the multi-core machine cable connected to the electrical connection device can be performed without the need to dismantle the electrical connection device.

Alternatively, the end-face of the body may be conductive. In this case the nuts preferably are electrically connected to the end-face. A continuos earth-connection to another electrical device is possible by face-to-face connection to the other electrical device if the other electrical device has suitable means for connecting earth potential to the end-face or the nuts. Technical testing procedures of the multi-core machine cable connected to the electrical connection device only require unscrewing the nuts such that the earth potential layers are electrically separated.

In a preferred form, each insulating sleeve may also be arranged such that, in addition to the pin or socket that is positioned within the sleeve and when the electrical connection device is connected to another electrical device, a socket or pin, respectively, of another device is positioned within the insulating sleeve.

In one preferred embodiment of the invention the multi-core machine cable is a three-core machine cable. In this case the electrical connection device preferably

comprises three apertures and three insulating tubes associated with the apertures.

The body may comprises a metallic exterior surface. However, if in use earth potential layers of the individual cores of the multi-branch machine cable are connected to individual ones of the conductive layer, there may be no need for a metallic body for earthing purposes. Thus, the body preferably comprises an exterior surface portion that is electrically insulating and most preferably is itself electrically insulating and may be composed of polymeric material.

Optionally, each insulating sleeve may be surrounded by a plurality of conductive layer which are electrically isolated so that, in use, a plurality of separate earth potential screens may be established.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief description of the Drawings

Figure 1 shows a schematic cross-sectional representation of an electrical connection device according to a preferred embodiment of the invention,

Figure 2 shows a schematic cross-sectional representation of an electrical connection device according to a variation of the preferred embodiment of the invention,

Figure 3 shows a view of an end-face of the electrical connection device,

Figure 4 shows a schematic cross-sectional representation of the electrical connection device according to another preferred embodiment of the invention connected to another electrical connection device

according to a further preferred embodiment and

Figure 5 shows a schematic cross-sectional representation of an electrical connection device according to a further preferred embodiment of the invention.

Detailed Description of Preferred Embodiments of the Invention

Referring to Figures 1 to 3, the electrical connection device 10 is now described. Figure 2 shows a variation of the device that is in part shown in Figure 1. For clarity, however, the same reference numerals have been used in Figures 1 and 2 for parts that have the same function.

The device 10 comprises a body 11 that is of substantially cylindrical shape and has an outer shell composed of a metallic material. Figures 1 and 2 show representative portions of the device 10. The bulk of the body 11 is composed of an insulating material. The body 11 has an end-face 14 that has three apertures (see Figure 3) that are defined by nuts 16, 18 and 20. From each aperture an insulating sleeve 22 projects inwardly. Each insulating sleeve 22 has a threaded end-portion 23 that is arranged to receive respective nuts 16, 18 or 20. Each insulating tube 22 is surrounded by a conductive layer 24 and locates a pin 26. The pin 26 is connected to a connector 28 which is connected to an individual core 29 of a multi-core machine cable (not shown). The multi-core machine cable is of the type having earth layers 31 individually surrounding insulated cores.

The earth layer 31 is in contact with cold-shrink sleeve 32. The cold shrink sleeve 32 surrounds a portion of the earth layer 31 and also a portion of the conductive

layer 24 of the insulating sleeve 22. The cold shrink sleeve 32 has a conductive layer on its interior surface which establishes an electrical connection between the earth potential layer 31 and the conductive layer 24. The cold shrink sleeve 32 is in part surrounded by a further cold shrink sleeve 33 which is arranged to reduce the likelihood that moisture from the machine cable may penetrate into the electrical device 10. Cold shrink sleeve 34 (see Figure 2) in part surrounds an end portion of sleeve 22 and is arranged to reduce the likelihood that moisture penetrates from the insulating sleeve 22 along core 29 into the machine cable.

Connector 28 is connected to a single core 29 of the multi-core cable and the respective earth potential layer 31 is connected to the conductive layer 24. Therefore, the core 29 and any conductive portions that may be in electrical contact with the core are, is within the body 11 individually surrounded either by the conductive layer 24 or the respective earth potential layer 31 of the multi-core cable. The conductive layer 24 is connected to the nut 16 which is, in this example, metallic.

In this embodiment the end-face 14 of the body 12 is composed of an insulating material. Therefore, for each core of the machine cable an individual earth connection is established within the electrical connection device 10 and can be individually continued to another electrical connection device (not shown) via the faces of nuts 16, 18 and 20.

In a variation of this embodiment, the end-face 14 may also be composed of a conductive material. In this case the end-portion 14 and the nuts 16, 18 and 20 have, in use, a common earth potential.

Figure 4 shows a portion of the electrical connection

device 10 connected to another electrical connection device 40. In this example the nut 16 is replaced by nut 16a which is composed mainly of an insulating material but has a metallic thread that is in contact with conductive layer 24 of sleeve 22. The other electrical connection device comprises two sockets 51 which are electrically connected and an insulating body 54. The other electrical connection device 40 and the electrical connection device 10 are arranged so that so that one of the sockets 51, when connected to pin 26, is positioned within the insulating sleeve 22. Individual earth connections are established via conductive sleeve 56 which is positioned at least in part within insulating body 54. Thus, the individual earth layer of the respective core of the machine cable (not shown) is connected via the conductive layer of the cold shrink sleeve 32 (see Figure 1), the conductive layer 24 of the insulating sleeve 22 and the conductive thread of nut 16a with conductive layer 56. The other electrical connection device 40 may receive a further electrical connection device of the same type as electrical connection device 10 and the assembly of the devices therefore would provide an electrical connection between two multi-core machine cables in which individual earth potential layers are continued individually.

Figure 5 shows another embodiment of the present invention. The Figure shows a coupling device 60 that comprises two electrically connected sockets 51 and an insulating sleeve 61. Three of the devices 60 may be used to electrically connect two devices 10 shown in Figure 1 - 3. Each of the devices 60 is, in this case, arranged to fit into respective apertures defined by nuts 16, 18 and 20. If two devices of the type shown in Figures 1-3 are connected using three devices 60, continuos and individual

earth connections may be established by face-to-face connection of the nuts 16,18 and 20 of the respective devices 10.

Although the invention has been described with reference to particular examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms. For example, the pin 26 may only partially be positioned within the insulating tube 22 and it may extend through the aperture of the nut 16. Also, the insulating tube 22 may have a socket 51 positioned within its interior instead of the pin 26. Optionally, one tube may have a pin and another tube may have a socket positioned within its interior. The electrical connection device 10 may be arranged for connection to any type of connection device including a lug and other electrical device.

The Claims defining the Invention are as follows:

1. An electrical connection device for connecting a multi-core machine cable to a another electrical device, the multi-core machine cable being of the type having insulated cores individually surrounded by earth-potential layers, the device comprising:

- a body having an end-face, the end-face having apertures,
- insulating sleeves associated with the apertures and extending from the end-face into the body,
- coupling means, each coupling means being connectable to an individual core of the machine cable and is positioned at least in part within a respective one of the insulating sleeves and
- conductive layers surrounding respective insulating sleeves

wherein, in use, each coupling means is connected to a core at a connection area, each conductive layer is connected to a respective earth potential layer, each conductive layer and each insulating sleeve being arranged such that each connection area is surrounded by the insulating sleeve and by the conductive layer.

2. The electrical connection device as claimed in claim 1 wherein each connection means is, in use, surrounded by a respective insulating sleeve and by a respective conductive layer.

3. The electrical connection device as claimed in claim 1 or 2 arranged such that, within the body, each core and the respective coupling means are, in use, surrounded by a

respective conductive layer or by the earth potential layer of the respective core.

4. The electrical connection device as claimed in any one of the preceding claims wherein each insulating sleeve is surrounded along its length by a respective conductive layer.

5. The electrical connection device as claimed in any one of the preceding claims wherein the coupling means comprises, or is connected to, a pin.

6. The electrical connection device as claimed in any one of claims 1 to 4 wherein the coupling means comprises, or is connected to, a socket.

7. The electrical connection device as claimed in any one of the preceding claims comprising ring-like contacts, each ring-like contact being positioned at or within a respective one of the apertures and electrically contactable with respective ones of the individual conductive layers.

8. The electrical connection device as claimed in any one of the preceding claims wherein the insulating sleeves are provided in form of tubes.

9. The electrical connection device as claimed in claim 8 wherein each tube has a thread at one end.

10. The electrical connection device as claimed in claim 9 wherein the ring-like contacts are provided in form of

nuts that are receivable by the threads of the insulating tubes.

11. The electrical connection device as claimed in claim 10 wherein, in use, each conductive layer is in electrical contact with a respective nut.

12. The electrical connection device as claimed in any one of the preceding claims wherein the end-face is electrically insulating.

13. The electrical connection device as claimed in any one of claims 1 to 11 wherein the end-face is electrically conductive.

14. The electrical connection device as claimed in any one of the preceding claims arranged such that, when the electrical connection device is connected to another electrical device, a coupling means of the other electrical device is positioned at least in part within a respective one of the insulating sleeves of the electrical connection device.

15. The electrical connection device as claimed in any one of the preceding claims wherein the multi-core machine cable is a three-core machine cable and the electrical connection device comprises three apertures and three insulating tubes associated with the apertures.

16. The electrical connection device as claimed in any one of the preceding claims wherein the body comprises an exterior surface portion that is metallic.

17. The electrical connection device as claimed in any one of the preceding claims wherein the body comprises an exterior surface portion that is electrically insulating.

18. The electrical connection device as claimed in any one of the preceding claims wherein the body is electrically insulating.

19. The electrical connection device as claimed in claims 18 wherein the body is composed of a polymeric material.

20. The electrical connection device as claims in any one of the preceding claims wherein each insulating sleeve is surrounded by a plurality of conductive layer which are electrically isolated so that, in use, a plurality of separate earth potential screens may be established.

DATED this 28th day of MARCH 2003
HEAD ELECTRICAL INTERNATIONAL PTY LTD

By their Patent Attorneys
GRIFFITH HACK

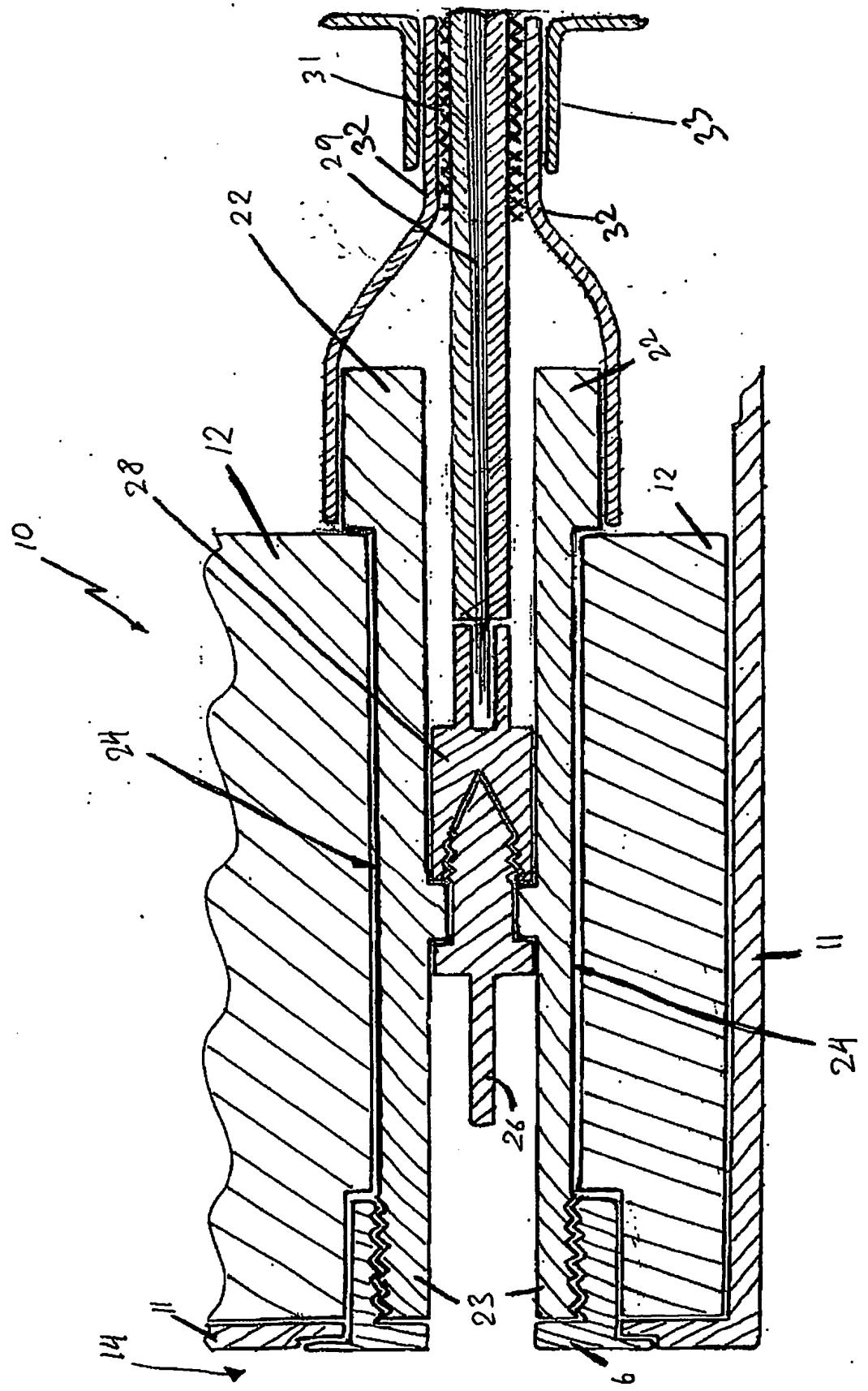

FIG. 1

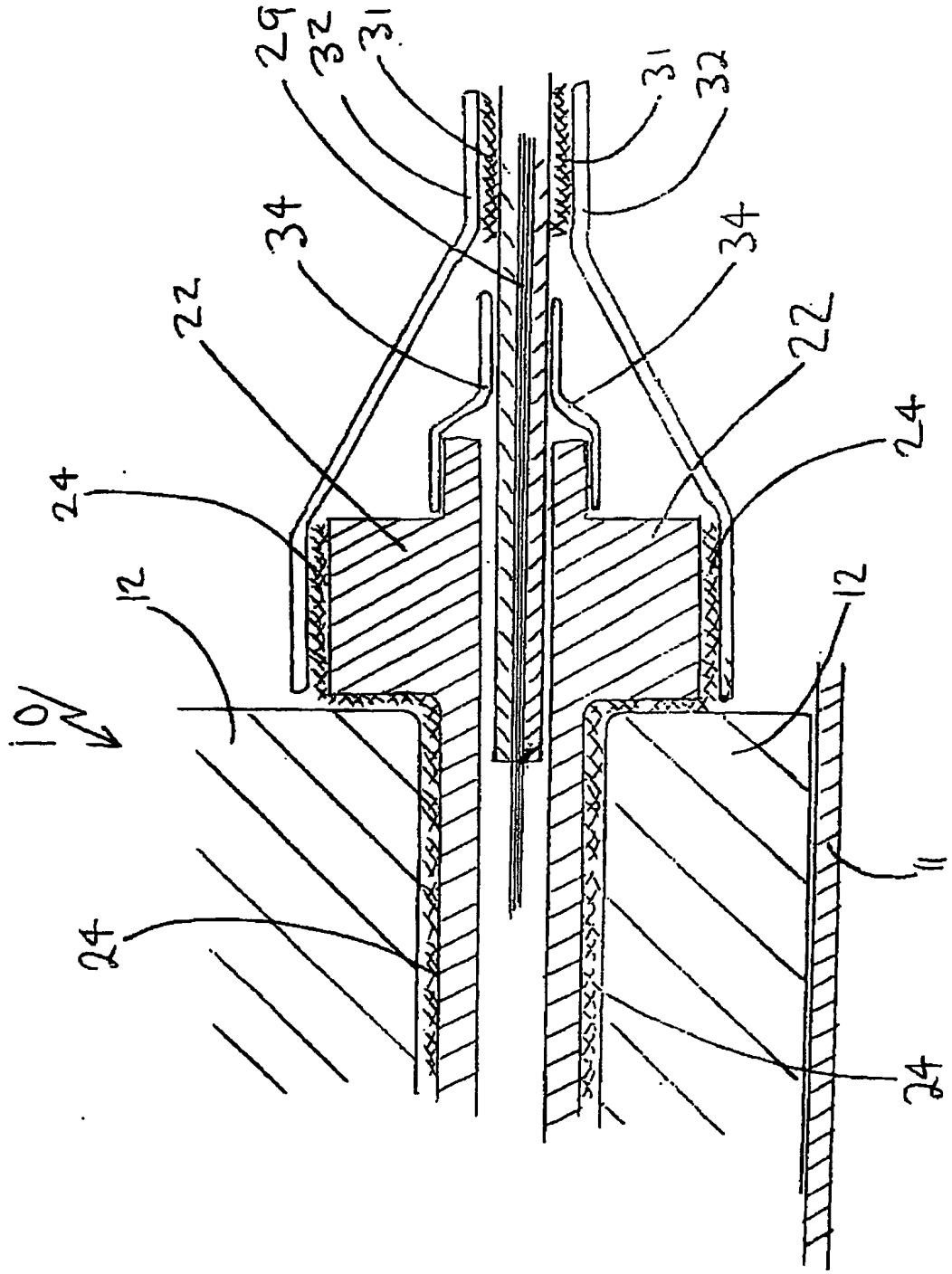

FIG. 2

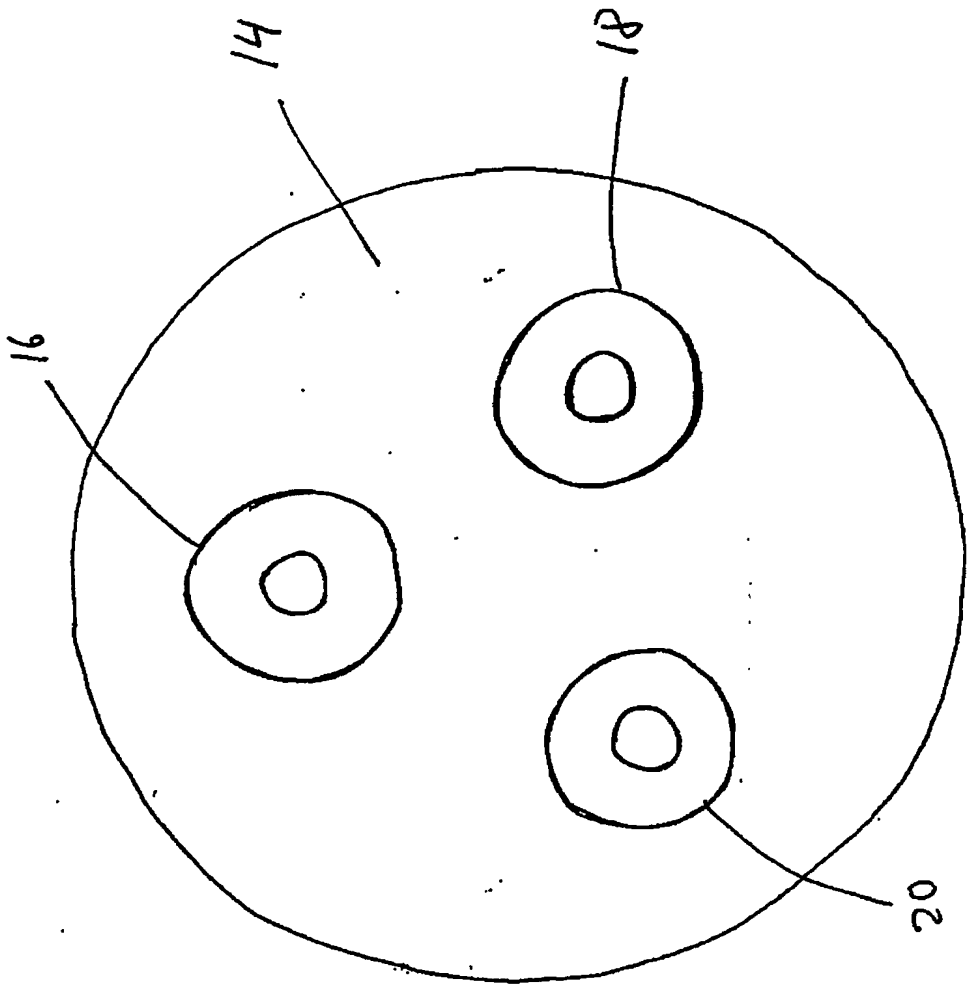

FIG. 3

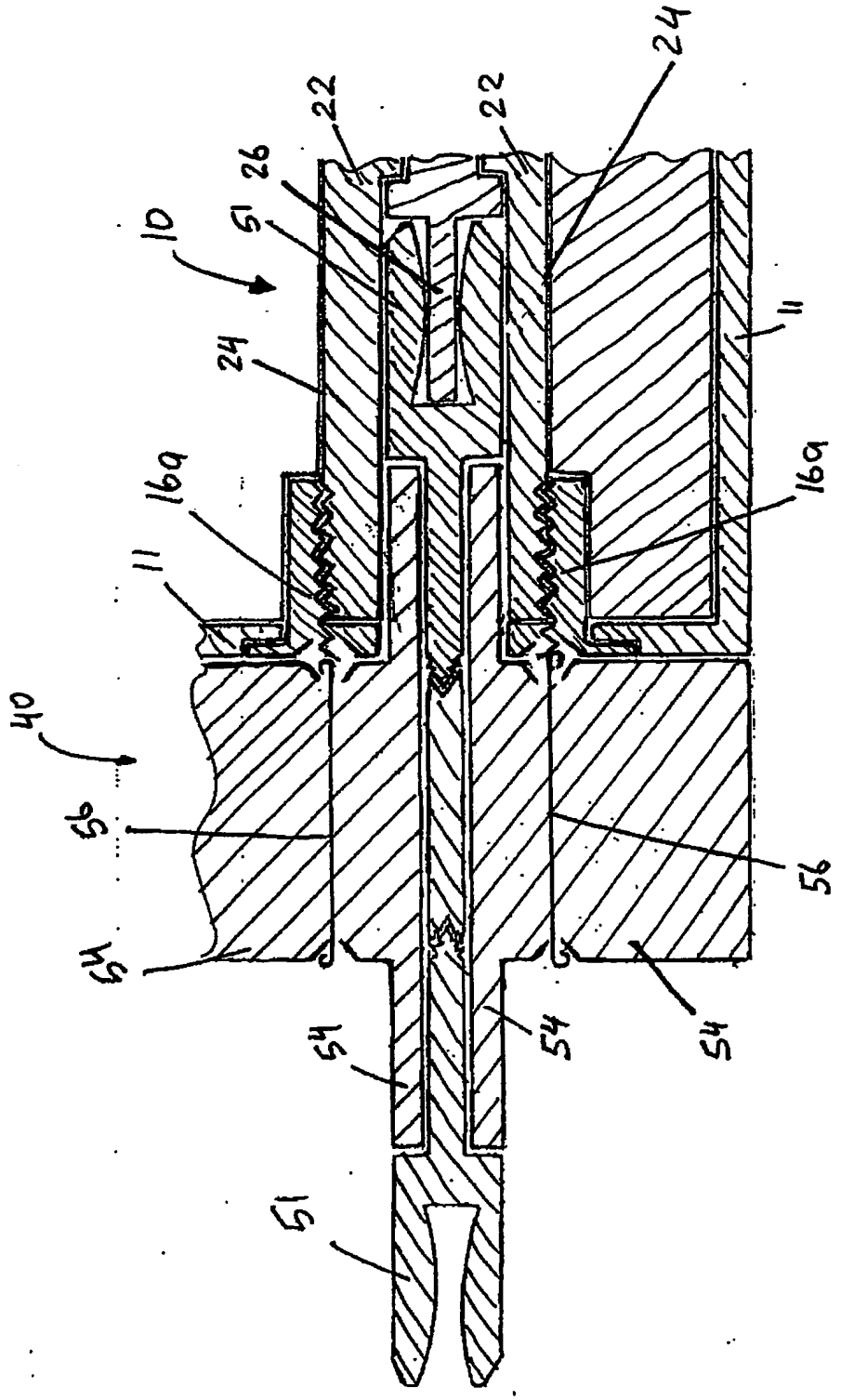

FIG. 4

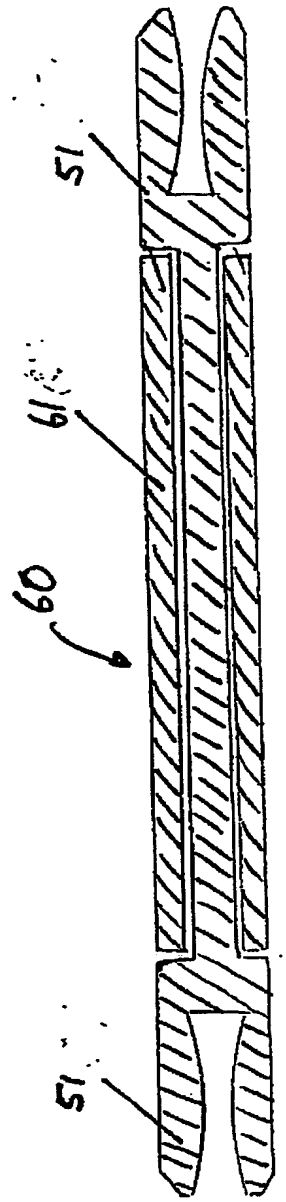

FIG. 5